EMBRYOLOGY

DEFINITIONS & BRANCHES of EMBRYOLOGY

- Branch of Biology concerned with study of embryo & events that occur during Prenatal developmental stage.

→ Branches

1. Descriptive Embryology -
   Morphological description of different embryonic stages

2. Comparative Embryology
   Comparative study of embryology of different animals groups.

3. Experimental Embryology

4. Chemical Embryology -
   Various Biochemical, biophysical & physiological techniques for understanding embryological events at molecular level

5. Teratology -
   concerned with the study of malformations or birth defects.

DOMS Page No.
Date / /

EMBRYO -

It is the early stage of development of multicellular organism.

5th to 10th week.

- Development of 3 primary germ layer that give rise to all structures & basic body shape
- The process of formation & development of embryo is called EMBRYOGENESIS
- Measures about - 0.6 inch
- 6 - 10 days after fertilization, the embryo attaches itself into the lining of uterus & process is called Implantation.

FETUS -

It is the unborn offspring of a human inside the uterus (womb) more than 8 weeks after conception.

- Measurement - 2.1 inch
- Fetal development begins from the 9th week / 11th after fertilisation & continues until birth.
- By 12 weeks of pregnancy, the fetus fills the entire uterus
- Aborting / destroying a fetus - Feticide. (at fetal stage)

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SPERM OVUM FERTILIZATION

→ SPERM

- It is male reproductive cell / gamete, they are motile & consist of tail
- Process - spermatogenesis
- It takes place in seminiferous tubules.
- sperms are smaller than female gamete
- sperms cannot divide & have limited life span.

→ OVUM

- It is the female reproductive gamete, they are non motile
- Process - oogenesis
- It takes place in ovaries
- Larger than the male gamete
- Ovulation -

  Process by which mature ovum is released from ovary.

→ FERTILIZATION

- It is the union of a human egg & sperm, usually occuring in ampullar-isthemic junction of fallopian tube
- This results in the production of zygote.

Clinical Anatomy -

In vitro fertilization

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DOMS Page No.
Date / /

CLEAVAGE

- After fertilization, the development of a multicellular organism proceeds by a process called cleavage
- A series of mitotic divisions whereby daughter cells are genetically similar to parent cells.
- These cleavage stage cells are called Blastomeres.
- As the cleavage proceeds Blastomeres become smaller & smaller so it called fractionating process.
- Around 24 hours after fertilization occurs the first cleavage division occurs.

GERM LAYER - formation, derivation & importance.

- Germ layers form during the process of gastrulation, when blastula begins to differentiate into more specialized cells that become layered across the developing embryo
- Germ layer, any of 3 primary cell layers formed in the earliest stages of embryonic development.
  - Endoderm (inner layer)
  - Mesoderm (middle layer)
  - Ectoderm (outer layer)

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→ Derivatives

1] Ectodermal derivatives-
   a] Skin, hair
   b] Teeth, nail
   c] CNS, PNS
   d] oral cavity
   e] sweat gland

2] Endodermal derivaties-
   a] Lining of tube from nose, mouth & ear to anus
   b] GI Tract (except spleen)
   c] Urinary system

3] Mesodermal derivaties-
   a] All substances b/w skin & internal organs
   b] Spleen
   c] Heart
   d] Cardiac, skeletal & smooth muscle
   e] RBC

→ Importance
- Contribute to the formation of all organs & tissues.

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DOMS Page No.
Date / /

CHROMOSOME

- The number of chromosomes in each cell is fixed for human beings, it is 46.
- In spermatozoa & ova, the no of chromosomes is only half the diploid no - 23

23 - Haploid no
46 - diploid no

- Fertilization - 23 (sperm) + 23 (ovum)
  = 46 (diploid) zygote.

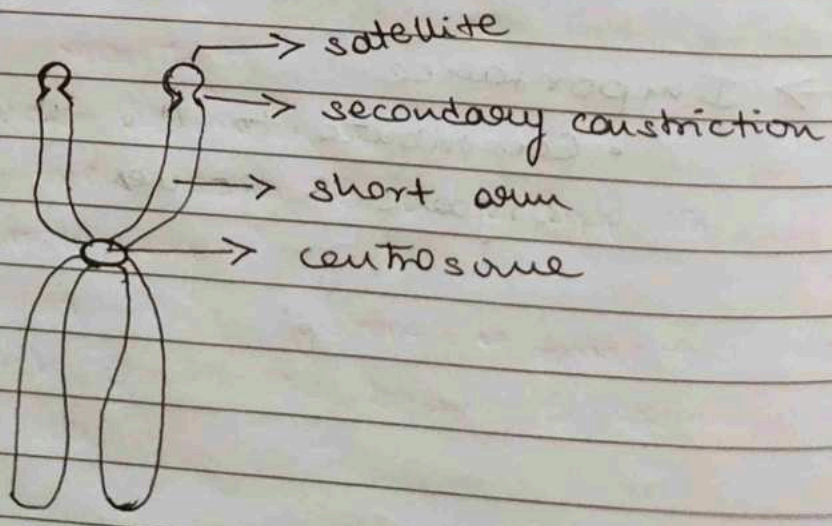
→ SEX DIFFERENTATION

- 46 chromosomes in each cell can be divided into 44 autosomes & 2 sex chromosomes

sex chromosomes [X
                  Y

- Male - 44 autosomes + X chromosome + Y chromosomes
- Female - 44 autosomes + 2 X chromosomes

→ STRUCTURE



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→ SIGNIFICANCE of CHROMOSOMES

- The entire human body develops from fertilized ovum
- This tremendous volume of information is stored within the chromosomes of each cell, which is necessary for formation of tissues & organs of the body.
- Each chromosome bears on itself a very large no of structures called genes.
- Traits (characters) of an individual are determined by genes carried on his/her chromosomes.

→ TYPES

1 Metacentric - Centromere is centrally placed & 2 arms are of equal length

2 Submetacentric - centromere is slightly away from the centre & one arm is somewhat shorter than other

3 Acrocentric - centromere is nearer to 1 end one arm is much shorter than other

4 Telocentric - centromere lies at one end

→ APPLIED ANATOMY

- Down syndrome
- Turner's syndrome.

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PLACENTA

- It is a fetomaternal organ
- The stru & func unit b/w developing embryo / fetus & maternal body is called Placenta.
- It connects growing embryo / fetus with wall of pregnant uterus
- It fuses the fetal organ to maternal tissue for the purpose of physiological exchange.

→ SHAPE - DISC SHAPED

→ WEIGHT - 500g

→ SURFACE -
- Maternal Surface
- Fetal surface

→ Structural component -
- Maternal component
- Fetal component

→ PLACENTAL MEMBRANE / BARRIER
- In the placenta, maternal blood circulates through the intervillous space
- Fetal blood circulates through blood vessels in villi
- Though the maternal & fetal bloods are flowing side by side & in opposite direction, they don't mix with each other.
- They are separated by a membrane constituting of the structure -
  - Endothelium
  - Mesodesm.

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→ FUNCTION

- It acts as a temporary organ where interchange of O_2, nutrition & waste products takes place b/w fetus & maternal blood
- Acts as a barrier & prevents many bacteria from reaching fetus
- It keeps the blood streams separate
- synthesizes hormones [Progesterone
  Estrogen.

→ Clinical Anatomy -

Placental insufficiency

UMBLICAL CORD

- The placenta is connected to the embryo thru a cord i.e Umbilical cord which helps in the transport of substance to & from the embryo.

- Origin - develops from connecting stalk
- Insertion - foetal surface of the placenta
  - at the center
  - Near the center
- Length - 50 cm
- Diameter - 2 cm
- COMPONENTS -
  1. Umbilical vein
  2. Umbilical arteries

- DEVELOPMENT of Cord
  - Primitive umblical ring
  - Primitive umblical cord
  - Definitive umblical cord

1. Primitive Umblical ring -
   - Expansion of amniotic cavity, leads to folding & formation of primitive umblical ring.

2. Primitive umblical cord -
   - Expansion of amniotic cavity leads to elongation of umblical cord

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3 Definitive umbilical cord
- One persistence umbilical vein & 2 umbilical arteries are formed
- Mesoderm of connecting stalk is transformed into wharton's jelly

→ Clinical anatomy -
- short cord
- long cord
- presence of one umbilical artery
- Umbilical knot

AMNION
- It is a membranous sac which surrounds & protects the embryo
- Inner membrane of amnion contains amniotic fluid
- It allows the fetus to move freely
- Amniotic fluid which causes the amnion to expand & become the amniotic sac which serves to provide a protective environment for developing embryo / fetus

→ Clinical Anatomy -
Amniotic Band Syndrome

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CHORION

- It is a double layered membrane formed by the trophoblast (2 layers) & extra embryonic mesoderm which eventually will give rise to fetal part placenta.
- chorion & amnion together form amniotic sac
- chorionic fluid protects the embryo from shock
- Allows exchange of nutrients, O_2 & waste products with the mother
- Chorion is membrane that surrounds the amnion
- finger like project - chorionic villi

→ Clinical anatomy -

- chorioamnionitis.
- dehydrated chorion.

BLASTULA

- It is a hollow sphere of cells / blastomeres produced during the development of an embryo by repeated cleavage of a fertilized egg
- The cells of blastula form an epithelial layer called BLASTODERM
- FLUID FILLED CAVITY - BLASTOCOEL
- 32 no of cells, later they rearrange into
  1. inner cell mass
  2. outer trophoblast.

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MORULA

- Cleavage proceeds & the ovum has 16 cells i.e 4th division
- It looks like Mulberry & called Morula
- Cells are similar in size & structure
- It is still surrounded by zona pellucida
- Morulla continues to divide & becomes blastocyst

CORPUS LUTEUM

- It is a mass of cells that forms in an ovary formed by the grafian follicle
- It secretes large amount of progesterone which is essential for maintainance of endometrium
- Its role depend on whether or not fertilization occurs

→ Clinical anatomy -

Corpus luteum cyst

- If egg is not fertilized corpus luteum becomes inactive after 10-14 days.

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GRAFIAN FOLLICLE / OVARIAN FOLLICLE

- 1st meiotic division -
  1° follicle matures to 2° follicle
  [1° oocyte]
- 2nd meiotic division -
  2° follicle matures into grafian follicle
  [2° oocyte]

- It secretes hormones that influences stages of the menstrual cycle.
- LH surge on 14th day, causes the rupture of the grafian follicle leading to ovulation.

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